**Unit Test**

**Solutions, Solubility, Acids & Bases**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_ Mark: \_\_\_\_\_/47**

**Instructions:**

1. Time allotted: 55 minutes.
2. Show all relevant steps in order to get full marks.
3. Scientific, non-graphing calculators are allowed.
4. Total 7 pages.
5. A periodic table has been provided at the end.

**Multiple Choice (1 mark each)**

1. In a concentrated solution, there is

a) No solvent.

**b) A large amount of solute.**

c) A small amount of solvent.

d) No solute.

1. In which of the following is concentration expressed in percent by volume?

**a) 10% (v/v)**

b) 10% (m/v)

c) 10% (m/m)

d) 10%

1. What can be done to crystallize a supersaturated solution?

a) Heat the solution.

b) It will crystallize if you leave it alone.

**c) Add a crystal of the solute or scratch the glass.**

d) Expose the solution to ultraviolet light.

1. Which of the following is LESS soluble in hot water than in cold water?

**a) CO2**

b) NaCl

c) NaNO3

d) KBr

1. What is the maximum amount of KCl that can be dissolved into 150.0 g of water?

(The solubility of KCl is 34.0 g/100 mL at STP.)

**a) 51.0 g**

b) 22.7 g

c) 34.0 g

d) 5.10 g

1. The solubility of a gas in a liquid

**a) Increases as the pressure of the gas above the liquid increases.**

b) Decreases as the pressure of the gas above the liquid increases.

b) Increases as the pressure of the gas above the liquid decreases.

d) Is unrelated to the pressure of the gas above the liquid.

1. Which type of mixture could most likely be filtered using filter paper?

a) A colloid

**b) A suspension**

c) A solution

d) An emulsion

1. Which of these statements regarding the water molecule is FALSE?

a) Oxygen is more electronegative than the hydrogen.

b) The electrons between the hydrogen and oxygen atoms in each bond lie more towards the oxygen than they do towards the hydrogen.

c) The hydrogen atoms are bonded to the oxygen at an angle of 104.5°, which gives the water molecule its characteristic bent shape.

**d) The water molecule is a non-polar molecule.**

1. How many moles of NaOH would be needed to make 0.0500 L of a 0.750 mol/L

solution?

a) 15.0 mol

**b) 0.0375 mol**

c) 50.0 mol

d) 0.750 mol

1. Identify the FINAL step to follow when preparing a solution.

a) Mass out the solute and add it to the flask.

**b) Add more solvent until you reach the required amount.**

c) Mass out the solvent and add it to the flask.

d) Add about half the required volume of solvent to the flask.

1. You start with a solution that is 0.800 mol/L and exactly 0.0700 L. You need to prepare a

0.300 mol/L solution. What is the final volume of the solution?

a) 3.43 L

b) 0.026 L

c) 0.580 L

**d) 0.187 L**

1. Which method of water treatment is useful for controlling disease-causing organisms

such as viruses, bacteria, and parasites?

a) Water softening

b) Filtration

**c) Chlorination**

d) Distillation

1. What is a characteristic of Arhenius acid?

**a) It reacts with water to form hydrogen ions.**

b) It turns red litmus to blue.

c) It turns phenolphthalein solution red.

d) It reacts with water to form hydroxide ions.

1. Which of the substances below are acids according to the Bronsted-Lowry theory of acids and bases? HCO3-(aq) + HS-(aq) <------> CO32-(aq) + H2S(aq)

a) HCO3-(aq) and CO3-2(aq)

b) HS-(aq) and CO3-2(aq)

**c) HCO3-(aq) and H2S(aq)**

d) HS-(aq) and H2S(aq)

1. 10 mL of 0.10 mol/L HCl(aq) requires 35 mL of NaOH(aq) for complete neutralization. The concentration of the NaOH(aq) is

a) 0.020 mol/L

**b) 0.029 mol/L**

c) 0.035 mol/L

d) 0.058 mol/L

1. The pH at the equivalence point of an acid-base titration is 3.8. This result would be consistent with the titration of a

a) Strong acid with a strong base

**b) Strong acid with a weak base**

c) Weak acid with a strong base

d) Weak acid with a weak base

**Short Answers**

*Answer each of the questions below using the space provided. Pay attention to the number of marks that each question is worth, as this may help you decide how much information to provide for full marks. For questions that involve calculations, show your work and check your final answer for the correct number of significant figures and the appropriate unit.*

1. Describe any three properties that are true of a solution in terms of the particulate view. *(3 marks)*

*Answer:*

Any three of the following properties for one mark each:

* Solutions are homogeneous.
* Their particles are spread evenly throughout the solution.
* They have a single phase.
* Their particles are too small to be seen.
* They are transparent.
* Their particles are too small to reflect light.
* Their components do not settle out.
* Their parts cannot be separated by filtration.

2. Write the equation for dissolving Ag2CrO4(*s*) in water. *(2 marks)*

*Anwers:* Ag2CrO4(*s*) → 2Ag+ (*aq*) + CrO42—(*aq*)

3. What is the number of moles of solute in 0.650 L of a 0.40 mol/L solution? *(2 marks)*

*Answer:* 0.26 mol

4. What’s the difference between a solution, a suspension, and a colloid? Give examples of each. *(4 marks)*

*Answer:*

Solution: When one thing dissolves in each other – a homogeneous mixture (salt water, etc). Colloid: When very small particles of one thing are suspended in another in a stable fashion (milk, etc).

Suspension: When larger particles of one thing are suspended in another and eventually settle out (ketchup, peanut butter).

5. What is the pH of a solution that contains 1.32 grams of nitric acid (HNO3) dissolved in 750 mL of water? *(3 marks)*

*Answer:* pH = 1.55

6. An acidic solution has a pH of 4. If I dilute 10 mL of this solution to a final volume of 1000 mL, what is the pH of the resulting solution? *(3 marks)*

*Answer*: The pH will be 6. This is solved in the same way that dilution problems are solved. If the pH = 4, this means that the concentration of [H+] present is 0.0001 M. When you use the dilution equation, M1V1 = M2V2, where V2 is 1000 mL, you find that the concentration of acid after dilution is 1.00 x 10-6, which corresponds to a final pH of 6.

**Application and Communication**

Use the solubility curve for KNO3 to solve these problems.



1. What is the approximate solubility of KNO3 at 30 °C? *(2 marks)*

*Answer:* 48 g/100 g H2O

1. Estimate the temperature at which the solubility of potassium nitrate is 50 g/100 g. *(2 marks)*

*Answer:* About 30 °C

1. Indicate which of the following sets of data represents a *saturated* solution of potassium nitrate. *(2 marks)*

**a) 25oC: 40 g/100 g H2O**

b) 63oC: 140 g/100 g H2O

c) 8oC: 10 g/100 g H2O

d) 74oC: 150 g/100 g H2O

1. Classify each of the following species as a Bronsted acid or base:
   1. HBr
   2. NO2-
   3. HCO3-

Write a chemical equation to show why each species is a Bronsted acid/base. *(8 marks)*

*Answer:*

a) HBr dissolves in water to yield H+ and Br- ions, i.e.

HBr (aq) 🡪 H+ (aq) + Br- (aq)

Therefore HBr is a Bronsted acid.

b) In solution the nitrite ion can accept a proton to form nitrous acid, i.e.

No2-(aq) + H+(aq) 🡪 HNO2(aq)

Therefore No2- is a Bronsted base.

c) The bicarbonate ion is a Bronsted acid because it ionizes in solution as follows:

HCO3-(aq) 🡪 H+(aq) + CO32-(aq)

It is also a Bronsted base because it can accept a proton to form carbonic acid, i.e.

HCO3-(aq) + H+(aq) 🡪 H2CO3(aq)

